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THE POTATO ASSOCIATION OF AMERICA

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The Value of Ordinary Field Practices In Determining the Adaptability of New Potato Seedlings

A. G. TOLAAS, University Farm, St. Paul, Minnesota

Recognizing the importance of the potato industry to the North Central area of the United States and especially to Minnesota, considerable attention has been given to the potato breeding problem by the Horticultural Division of the Minnesota Agricultural Experiment Station. Our chief varieties, consisting of Early Ohios, Irish Cobblers, Bliss Triumphs, Green Mountains, and Rural New Yorkers, all originated in sections of the Country where climatic conditions are somewhat different than our own. When one considers the fact that Minnesota itself is approximately 400 miles long from north to south and from 250 to 300 miles from east to west, and that within this area are contained numerous variable soil types and that the average annual rainfall varies from 18 to 20 inches in the Red River Valley section to 28 to 30 inches in the southeastern part of the state, one can readily see that our potatoes are subjected to considerable variation during their growth period, even in our own state.

Although every farmer in the state raises some potatoes, the chief potato growing regions are to be found in the Red River Valley, the northeast section, extending from the eastern boundary of the Red River Valley to the eastern boundary of the state, and the "sand land" region comprising some ten or twelve counties adjacent to the Twin Cities and extending to the southern boundary of the northeast section. These regions comprise the commercial growing areas, although a small commercial growing area does exist in the southwest corner of the state and at Hollandale, one hundred miles directly south of the Twin Cities, where Irish Cobbler potatoes, celery, and onions are raised on some 15,000 acres of reclaimed peat bog.

Practically all of the potato acreage in the Red River Valley is planted to Irish Cobblers and Early Ohios. Bliss Triumphs, Irish Cobblers and Green Mountains are the varieties chiefly grown in the northeast section. In the "sand land" area the chief varieties grown are Early Ohios, Bliss Triumphs, Irish Cobblers, and Rural New Yorkers. Large tracts of peat occur in the "sand land" area and a great deal of success has been attained by some growers with Triumphs and Cobblers on this type of soil in this region.

At this particular time we are interested in developing potato varieties of good quality, that will mature as early or earlier than the Bliss Triumph, that will yield better than the Irish Cobbler, and that will be as smooth as the Rural New Yorker. Such a variety would be of great value to our seed producing areas and to the "sand land" areas in which potatoes are grown for the early market.

The development of resistance to such destructive virus diseases as mosaic, leaf roll, and spindle tuber is being included in the potato breeding program. Potato growing on our peat bogs has also brought out the fact that scab and Rhizoctonia may be particularly destructive on this type of soil and both of these diseases are being taken into consideration, because there are thousands of acres of peat in the state which when properly drained, prepared and fertilized will outyield the adjacent mineral soils, three bushel to one. Besides frost, both of these diseases seem to be limiting factors on our peat soils. That scab may constitute a rather serious drawback to potato growing on peat soils was very clearly demonstrated during the past two years when lack of moisture was so great that scab was very prevalent on some of our peat bogs.

The foregoing are but a few of the factors which need to be considered in the complex problem of developing suitable varieties. Some progress has been made and in connection with seedlings developed at the Minnesota Agricultural Experiment Station and which appear to be promising, it seemed that considerable valuable information with reference to their suitability for Minnesota could be obtained by subjecting them in comparison with the standard varieties under ordinary field conditions.

The seedlings involved in this test were obtained from crosses made in 1926. The F_1 progenies were grown at University Farm in 1927 when the relative vigor of these progenies, based on yield, was obtained, but no individual selections were made. In 1928 these F_1 progenies were growing in families at the Northeast Branch Station at Duluth. Thus each plant in the family represented a different seedling. From the 1,488 seedlings, representing 47 F_1 families, 156 of the best seedlings were selected, representing 32 of the F_1 families. These

selected seedings were grown at the Northwest Branch Station at Crookston in 1929. From the 156 seedlings, 22 were selected for testing in 1930. The yields of these 22 seedlings for single plots in comparison to replicated plots of the standard varieties, were recorded in 1929. In 1930, these 22 seedlings were grown at Duluth, Grand Rapids, and Crookston, in replicated plots in comparison to the standard varieties. Because of an exceedingly hot and dry growing season, the yields were far below normal and there was considerable doubt as to whether the data obtained would be consistent with those which might have been obtained under more normal growing conditions. From the 22 seedlings grown, four were selected on the basis of their behavior in 1929 and 1930 for a comprehensive test in 1931 to determine their actual worth in comparison to the standard varieties.

The seedlings which were saved for this comprehensive test in 1931 are designated by the numbers 22-1C, 35-2C, 50-3C and 51-16C. All are earlier maturing than the Irish Cobbler. In addition to these seedings we received a quantity of the new U. S. D. A. seedlings, now known as the Katahdin, which was included in the field trials. Since the 1930 growing season was so unfavorable, the amount of stock obtained for these tests was about half of what we would have obtained, had growing conditions been anywhere near normal. The extremely hot and dry weather of 1930 and the fact that we were dealing with foliage characteristics, which were not as familiar to us as is the foliage of the standard varieties, made roguing for virus diseases rather uncertain. This was clearly demonstrated in the 1931 field tests in which our field inspections revealed the fact that we had missed a number of virus infected plants in the 1930 plots.

In order to facilitate inspection and roguing of the test plots, the seedlings were all harvested in hill units in 1930 and the cooperating growers instructed to plant the progeny from each hill as a unit, leaving enough space between each unit so that it could be identifid easily. Twelve of our progressive certified seed growers, located in different parts of the state were selected as cooperators. Table 1 gives the type of soil on each farm. It will be noticed that four of the growers are recorded as having glacial silt soil. All of these growers are located in the Red River Valley and, although their types of soil are listed as glacial silt, there are some differences in texture which should be mentioned. The soils on Mr. Askegaard's and Mr. Younggren's farms are both of an exceedingly fine texture and constitute what we commonly call a heavy gumbo soil. Mr. Flaat's farm is located on the strip of land between the Red and Red Lake Rivers, known as Minnesota Point, and although of a gumbo nature, has a looser texture than either of the other two farms. Mr.

Norum's farm, five miles east of Hallock is situated where the gumbo shades off into a sandy type of soil. Aside from the fact that the seedlings were planted on the hill unit basis as mentioned above, all field operations were identical with those used on the cooperators' own fields. If a seedling appeared worthy for further propagation, we were to receive three-fourths of the crop for further dissemination among growers this coming year, the cooperator to retain one-fourth. The plots were inspected twice during the growing season by the certification inspectors of the department when they made the regular field inspections, and any roguing necessary was done by them. With the exception of the plots on O. J. Odegard's farm, all plots were harvested by one of the certification inspectors and the writer.

Each of the four seedlings grown had a distinct type of growth and tuber shape. It is not necessary here to go into any detail with reference to growth characteristics except insofar as they pertain to the possible value of the seedling as a commercial variety. The yields given in Table 1 are apt to be slightly misleading if the maturity of the seedlings and varieties is not taken into consideration. From the data on maturity, it will be noticed that 51-16C is the earliest in the test, closely followed by 22-7C, 35-2C and the three early varieties, Triumph, Cobbler and Early Ohio. 50-3C is a few days later in maturing than the group mentioned above. The Katahdin and the Rural are very late maturing varieties. It is clear from the data that in these tests the early types almost invariably gave the highest yield, indicating that conditions favored the early types. Although 22-1C produced a rather good tuber type in the plots harvested, the average set per plant and the yield was low. It showed a very weak and scraggly vine growth and was very susceptible to mosaic so that it was rogued out entirely on most of the farms where grown. Because of the above mentioned characteristics it has been eliminated from further consideration. Number 35-2C was also eliminated by roguing on a number of farms. It has a rather vigorous vine growth, the stems being colored a deep purple and it does not seem to be quite so susceptible to mosaic as No. 22-1C. On the three farms where it was harvested, it approached the Irish Cobbler in yield. The tuber type of this seedling is superior to that of the Irish Cobbler, being somewhat like an elongated Rural New Yorker. It has one rather undesirable characteristic, as brought out in these tests, in that the stolens are quite long, which, of course, makes for difficult digging with the present type of potato diggers. However, the growers on whose farms we obtained harvesting data were so pleased with the type of tubers produced under their conditions that they are going to try it again next year. Under special conditions, and where

growers can afford a slight sacrifice in favor of a better tuber type, this seedling may have a place.

In the 1929 and 1930 test plots, 50-3C seemed to give promise because of its apparently good yielding ability, and for this reason it was included in the 1931 growers' tests. The yields of this particular seedling on the growers' fields, as indicated in Table 1, show that from this standpoint it has some merit, although for some unexplainable reason the yield on the Odegard bog was low. Although the yields of 50-3C on some of the farms indicate good producing qualities the average of the tests do not come up to the average yield produced by the Cobblers. These tests also brought out the fact that it has no definite tuber shape, which is a rather undesirable characteristic from the commercial standpoint. The lack of a definite tuber type occurred at all of the farms where it was grown. Number 51-16C appears to have a wide adaptability. It has a vigorous vine growth and, as shown in Table 1, proved to be a good yielder on all types of soil. It produced a higher average yield than any other variety or seedling in the test, probably being favored by its early maturity, which is about the same as Bliss Triumph, but it sets tubers earlier. In shape it is somewhat like the Irish Cobbler, white in color with pink eyes. Another interesting and desirable feature observed was the production of short stolons so that the tubers are borne close to the main stem. This is true whether it be grown on the mineral or peat soils. Another characteristic observed on all of the plots was the average good set of uniform tubers with a small percentage of culls. In very few hills did we find any great difference in size between the largest and smallest tubers. There was very little difference between the shape of the tubers grown on the various types of mineral soil and those grown on the different peat bogs, although there was a tendency to coarseness on peat which can be overcome by closer planting. This seedling seems to be especially promising for our high line peat bogs because of its earliness in setting tubers and because of its early maturity, both important characteristics for a potato to be grown successfully on peat because of frost hazards. 51-16C produced very attractive tubers on the gumbo soils of the Red River Valley, but the most attractive tubers harvested were those grown on the sandy clay loam of the H. M. Johnson farm at Clearbrook. As far as this test indicates, this seedling should become a suitable early variety for our growers. Unfortunately, we had no plots in the "sand land" area on mineral soil to compare it with the Ohios and Cobblers customarily grown in this region, but we are planning for such a trial to be made in 1932.

On all of the plots, except on the farms of O. J. Odegard and R. C. Rose, the seedlings were planted and harvested on the

Table 1—Results of Seedling Test Plots Grown on 11 Farms in 1931.

	E. D. Askegaard	O. A. Flaat	Geo. Ghostley	H. M. Johnson	A. Norum	O. J. Odegard
Variety	Moorhead	Fisher	Anoka	Clear-brook	Hallock	Prince-ton
	Bu. per A.	Bu. per A.	Bu. per A.	Bu. per A.	Bu. per A.	Bu. per A.
51-16C	135	258	210	299	330	300
22-1C	96					120
35-2C	135			256	194	
50-3C	96	258	204	256	194	143
Katahdin	135	258	194	255	194	201
Irish Cobbler	194	232	358	210		300
Bliss Triumph	116			255		
Early Ohio					251	
Rural						
Maturity: 51-16C	Killed by grass-hoppers	Matured by Aug. 28	Almost matured by Aug. 28	Fully matured when dug	Beginning to mature when dug	Killed by frost Aug. 28
22-1C	Killed by grass-hoppers					Killed by frost Aug. 28
35-2C	Killed by grass-hoppers			Fully matured when dug	Vines green when dug	
50-3C	Killed by grass-hoppers	Almost matured by Aug. 28	Killed by frost Aug. 28	Fully matured when dug	Vines green when dug	Killed by frost Aug. 28
Katahdin	Killed by grass-hoppers	Killed by frost	Killed by frost Aug. 28	Leaves dried; vines still green when dug	Vines entirely green when dug	Killed by frost Aug. 28
Irish Cobbler	Killed by grass-hoppers	Almost matured by Aug. 28	Killed by frost Aug. 28	Fully matured when dug		Killed by frost Aug. 28
Bliss Triumph	Killed by grass-hoppers		Almost matured on Aug. 28	Fully matured when dug		
Early Ohio					Beginning to mature	
Rural						
Soil	Glacial silt	Glacial silt	Peat	Sandy clay loam	Glacial silt	Peat
Planting Date	May 15	May 30	May 25	May 22	?	May 12
Commer-cial Fertilizer	None	2-14-4 350 lbs. per acre	0-9-27 600 lbs. per acre	None	?	2-9-7 1000 lbs. per acre
Date Harvested	Sept. 17	Sept. 18	Sept. 15	Sept. 21	Sept. 19	Aug. 29

Table 1—(Continued)

Variety	R. C. Rose	E. Schroeder	E. E. Schulke	E. Westergren	Chas. Younggreen
	Forest Lake	Glyndon	Ten-strike	Bertha	Northcote
	Bu. per A.	Bu. per A.	Bu. per A.	Bu. per A.	Bu. per A.
51-16C	319	424	348	249	224
22-1C			163		
35-2C					224
50-3C	418	379		266	
Katahdin	205	290		382	290
Irish Cobbler	325	313		216	
Bliss Triumph					
Early Ohio					
Rural					201
Maturity: 51-16C	Killed by frost Aug. 28	Matured on Aug. 28	Leaves dried, vines green when dug	Matured before Aug. 28	Matured when dug
22-1C			Leaves dried, vines green when dug		
35-2C					Matured when dug
50-3C	Killed by frost Aug. 28	Practically matured Aug. 28		Almost matured on Aug. 28	
Katahdin	Killed by frost Aug. 28	Still green when dug		Leaves dead; stems green when dug	Vines green when dug
Irish Cobbler	Killed by frost Aug. 28			Almost matured on Aug. 28	
Bliss Triumph					
Early Ohio					
Rural					Vines green when dug
Soil	Peat	Glacial silt	Nebish loam	Clay loam	Glacial silt
Planting Date	May 16	May 10	May 26	May 15	May 29
Commercial Fertilizer	0-9-27 400 lbs. per acre	None 560 lbs. acid phos.in1930	None	None	None
Date Harvested	Sept. 11	Sept. 16	Sept. 21	Sept. 16	Sept. 18

hill unit basis. The progeny of each of the hill units of 51-16C constituting the cooperator's share was put in a separate bag and will be planted as a hill unit in 1932. The rest of the stock has been distributed among 100 certified seed growers for trial by them. We are suggesting that each of these growers plant the stock, which they receive, on the tuber unit basis for the purpose of facilitating roguing if any should be necessary. Inasmuch as this seedling is neither resistant to mosaic or spindle tuber, we are endeavoring to make inspection and roguing for these diseases as simple and easy as possible, and we feel that by harvesting and separating the units for the original growers and by having the new growers plant their lots on the tuber unit basis, we will be accomplishing a great deal with a minimum amount of effort. We are naturally interested in the possibilities of this seedling and in connection with our own trials in Minnesota in 1932, it will be tried out in nine places in the South in comparison with the Bliss Triumph and Irish Cobbler.

Before closing, a word or two should be said about the new U. S. D. A. seedling which has been named Katahdin, and which was also included in these seedling tests. The Katahdin potatoes, sent to our growers, were grown in Maine in 1930 and submitted by the Horticultural Division of the U. S. Department of Agriculture. These tubers were distributed among eighteen growers including the certified seed growers whose records are included in Table 1. This seedling is late maturing and of excellent type. Although we realized that a late maturing variety is not particularly adapted to our peat soils on account of the ever present frost hazard, we were interested to see what the type would be and how it would yield if frost did not interfere. Unfortunately a general severe frost did occur on August 28 and everything that was green on the peat bogs froze to the ground. However, the frost did not touch the vines on Charles Younggren's farm at Northcote, Arthur Norum's farm at Hallock, nor on H. M. Johnson's farm at Clearbrook, and it was very light on Elmer Westergren's farm at Bertha. In fact, when we dug these four plots, the Katahdin vines were not quite matured. Of these four plots, the one test at Bertha falls in the Rural territory, where we obtained a yield of 382 bushels per acre, distinctly outyielding the Irish Cobbler. Since no Rurals were grown on Mr. Westergren's farm no comparison can be made. However, on the two other farms in the Rural territory where the Katahdin was grown, we have a comparison with a late variety. On one of these the growers obtained 210 bushels of Katahdins per acre as compared with 190 bushels of Green Mountains, while the other grower reported no difference in yield between the Katahdins and Rural New Yorkers except that there was a larger percentage of culls in the Rurals. On Mr. Younggren's

farm the Katahdins yielded 290 bushels per acre as compared to 201 bushels for the Rurals. Although the conditions of 1931 favored the early varieties and Minnesota seedlings, putting the Katahdin at a disadvantage in most of the tests, the comparisons with late varieties that we did get indicate that it is just as suitable to our conditions as is the Rural New Yorker. The fact that the Katahdin sets tubers earlier, which are superior to the Rural in type, gives it somewhat of an advantage over the latter. It also seemed to withstand the hot, dry summer fully as well. The type of the Katahdin was very good on all of the farms where we obtained records and the growers who tried it out praised it highly.

Potatoes are subjected to a wide range of growing conditions in Minnesota, and by proper choice of varieties it would seem that these conditions could best be met. These tests have brought out the fact that some of the seedlings are better suited to certain conditions than they are to others, but only No. 51-16C, on account of its several desirable characteristics seems to have a wide enough adaptability to be grown successfully throughout the state.

Potato Virus Diseases in 1931

DONALD FOLSOM, Maine Agricultural Experiment Station, Orono.

Virus diseases are also called viroses and degeneration diseases, and include mosaic, leafroll, and spindle tuber. This review does not cover the publications either published or already abstracted in the American Potato Journal or in the 1930 (Cleveland) Proceedings. (Folsom, 1931—see end of this paper for literature cited). This review is a condensation of one prepared for the New Orleans meeting. This review being about 30 per cent as long as when originally prepared, and attempting to represent originals totaling over 900 pages, many items of course have been omitted. An effort, however, has been made to present the most practical results and at the same time to indicate the nature of the more scientific contents.

Psyllid yellows. Richards, 1931: Produced by the young insects but not by the adults. Due to feeding only. Not systemic. Not perpetuated in tubers. Binkley, 1931: A "correction" appears to transfer some credit for publication.

Mosaic including those masked in potatoes. Skinner and Reed, 1930, p. 27-28, 73: Masked potato viroses in apparently healthy potatoes, in Jimson weeds, and other weeds. Report on their physical and chemical properties. One kind a constituent of tomato streak. One kind, found in all American potato varieties but not naturally in seedlings, causes various

symptoms in seedings. Valleau and Johnson, 1930: "The healthy potato virus" is the only one in apparently healthy potatoes. Identical with Johnson's tobacco "ringspots" disease. Virulence increased in tobacco. Causes rugose mosaic (same as tobacco spot-necrosis) when in combination with tobacco veinbanding virosis. Tobacco mosaics causing lesions in potato plants do not enter tubers. Cucumber mosaic infects potato. Tobacco ringspot rarely natural in potatoes. Three etch tobacco viruses infect potato. Chemical-physical properties less useful than symptoms. Valleau and Johnson, 1931: Healthy-potato virus in natural epidemic of tomato. Transmitted mechanically but not by insects. Henderson and Wingard, 1931: Healthy potato virus not same as tobacco ring-spot virus. Burnett and Jones, 1931: Occasional tuber free of latent virus that affects tomato. Russell and Clark, 1930, p. 40-41: Leaf-rolling mosaic, crinkle mosaic, and rugose mosaic on Green Mountains are distinguishable by symptoms which vary with the environment. Certain potato mosaics are different also in property tests. A healthy-potato virus is a mild form of rugose mosaic. Koch, 1931: Rugose mosaic is identical with tobacco spot necrosis and is mixture of a healthy-potato "mottle" virosis and a tobacco-vein-clearing virosis, both transmissible by extract and only the latter by aphids.

Kenneth M. Smith, 1931: Virus "x" (tobacco ring-spot) separated from virus "y" (tobacco vein-banding). Former alone infects certain plants while latter alone is carried by certain aphids. Kenneth M. Smith, 1931b: Several viroses cause tobacco ring-spotting. One transmitted to potato only by grafting, where it streaked the leaves, made the tubers hard, woody, and glassy inside, but did not ascend sprouts thus allowing recovery. Dorst, 1930: Mosaic transmitted by contact, knife, fingers. Botjes, 1931: Holland export seed trade shows improvement of susceptible stocks. Susceptibility tested better by tuber grafts than by field tests. Symptoms of stipple-streak, top-necrosis, and mosaic vary with the variety, being masked oftener than suspected two years ago. Similar symptom aggregates may be due to different causes. Battny, 1930; Symptoms of virus vary all the way to masked condition. Virus can pass cork layer in tuber graft.

Spindle tuber and unmottled curly dwarf. Newell, 1930, p. 102: Transmission of spindle tuber by knife, seed-piece contact, or planting machine, possible but practically unimportant. Goss, 1931: Insects less abundant in dry-land than in irrigated fields, latter having enough aphids to spread viroses. Both diseases transmitted by grass hoppers, flea beetles, tarnished plant bugs, and Colorado potato beetles, and spindle tuber by a leaf beetle. More infection with more insects or more inoculations. No transmission with grasshopper saliva or stomach

extract. Symptoms similar in all varieties. No transmission to various other solanaceous plants. Transmission by contact and knife to seed pieces prevented by seed treatment or drying, favored by moist soil. Infection by picker planter. Tuber in storage not completely infected by grafting to spindle tuber. Property studies reported. Insect dislike of unmottled curly dwarf may explain its comparative rarity. No harboring of either disease in soil.

Gussow, 1931, p. 177-180: Spindle tuber, quite prevalent in British Columbia, reduces electrical resistance of tuber tissues and extracted juice, and reduces dry-weight and ash percentages, but not significantly. The symptoms vary with variety and soil conditions. Verplancke, 1931: Presents averages of over 25,000 measurements on effect of spindle tuber on the tissues of Green Mountain tubers, and of about 13,000 on the starch grains. The disease increases length and decreases width of cells.

Leafroll. Hedrick, 1930, p. 40: No certain method of detection of the disease in tubers. Reduced in Irish Cobblers by discarding tubers with spindle sprouts. Aphids found on sprouts and thought to infect them. Stewart and Glasgow, 1931: Aphids infected sprouts without all parts of tuber becoming diseased.

Rusinov, 1930: Leafroll increased acidity and oxidizing ferments. Its reaction with methylene blue impractical for detection in tubers. Gussow, 1931, p. 207: Leafroll makes seed-pieces last longer in soil in Prince Edward Island. Kenneth M. Smith, 1931c: To transmit leafroll, spinach aphids require feeding on the diseased plant two or more hours, and further lapse of time before becoming able to infect. Aphid species vary in ability to transmit. Eosin stain was passed through the plant into and through aphids. U. S. leafroll is the same as British. Whitehead, 1931: Refers to a stock proved to be virus-free. Aphid species vary in effects of inoculation. Anon., 1930, 1930a, 1930b: Leafroll is designated as a filter passer. A review is included. Elze, 1931a: Aphid species and flea beetles vary in capacity to transmit leafroll. Mottling of aphids did not change their infectiveness. U. S. leafroll is the same as European. Schander, 1931, p. 52-55: Leafroll is correlated with certain physiological characteristics of the leaves but viroses were not correlated with various chemical constituents of leaves and tubers. Wartenburg, 1931: Describes fertilizer experiments and chemical analyses supposed to show that leafroll is strictly physiological rather than infectious. Eichinger, 1931: Criticises the preceding paper and distinguishes between the leafroll disease and ecological degeneration not perpetuated in the tubers. Merkenschlager, 1931: Replies to the preceding with generalities but not specific answers.

Two or more viroses as studied in America. Jardine, 1930 p. 15-16, 78-79: Potato leafroll and rugose mosaic can be harbored by various species of the potato family of plants. Aphid species vary in capacity to transmit leafroll. Crinkle mosaic and spindle tuber may reduce the yield 60 per cent. Roguing is most effective by tuber units. Hutchinson, 1931, p. 97: Spread of leafroll can be detected in the current season. Mild mosaic reduced yield 20 per cent. Mild mosaic and crinkle mosaic symptoms are masked in some fields but not leafroll and spindle tuber, in California. Hill, 1930, p. 8: Mosaic, spindle tuber, and curly dwarf symptoms are masked in certain parts of Wyoming. Kendall, 1931, p. 16: Lower temperature increased symptoms of leafroll and mosaic and increased their yield reduction, while increasing healthy yields and not affecting number of tubers per plant. Folsom, 1931a: Soil transmission not proved for leafroll. All tested Maine Green Mountains had masked mosaic. Leafroll contracted by healthy tuber line 900 feet from other potatoes. Gilbert and Popenoe, 1930: A short section of a revised farmers' bulletin is devoted to mosaic and leafroll.

Two or more viroses as studied in Europe. Lauder and Robertson, 1931: Find method of distinguishing varieties, by reagents used on tubers, not suitable for single tubers or for detecting leafroll or mosaic. Whitehead and Currie, 1931: Doubt value of greenhouse tuber indexing. Mosaic reduced yield up to 24 per cent, and leafroll up to 98 per cent, loss. With leafroll, varieties differ in proportion of tubers infected from diseased plants, in yield reduction, and in correlation between symptoms and yields. This disease not diagnosed by tuber hardness at planting, in 12,000 tubers. Both diseases in combination caused a "crinkle" in one variety. Lebard, 1930: In the Alps, the relative amounts of leafroll, mosaic, and curly dwarf, all present, varied with altitude and humidity, and with irrigation. Elze, 1931: Reviews literature on perpetuation of viroses through true seeds of potato and other plants. Latent viroses absent in Paul Kruger variety. Seedling symptoms not indicative of disease transmission. Leafroll sometimes masked in seedlings. Elze, 1931b: Points out some weaknesses in German theory of ecological causation of viroses. Describes proof of seed perpetuation of Aucuba mosaic and leafroll, indicating irregular features of results. Schaffnit and Muller, 1931: Report cross-inoculation tests including potato mottle-mosaic, curly-mosaic, Aucuba mosaic, and streak. Tobacco mosaic, no transmission to potato; healthy potato, no effect on tobacco; potato a symptomless carrier of tobacco mosaic from tobacco to tomato. Schander, 1930: Leaf parenchyma nuclei modified by viroses. Viroses do not affect protein and amide nitrogen content in tubers and plants, and effect on proteolytic and respiratory enzymes in tubers is overshadowed by other factors. Describes results of injecting certain solutions into leafroll plants. Transmission of mosaic and leafroll not secured and failure unexplainable. Leafroll percentage correlated with soil acidity, storage temperature, and working of soil, and increased by subjection of tubers to carbon dioxide. Schlumberger, 1930: Many cases of spread of viroses from diseased to neighboring healthy plants, indicating need of early roguing. Blattny, 1931: Spinach aphids feeding on leafroll, mosaic, and stipple-streak changed in structure of cell plasma of salivary glands. Bodies, inclusions, and histological changes not found. Rochlin, 1930: Phloem and other tissues modified by various viroses.

Potato viroses in general. Johnson and Hoggan, 1931: Too many names for viroses, which requires symptoms and property studies, uniform system

of nomenclature, and international committee. Quanjer, 1931: Discusses classification of viruses by symptoms, morbid anatomy and physiology; host range; modes of transmission; vector relations; effect of environment; cytlogy; virus cultivation; physical and chemical properties. Property studies are handicapped by various materials in extracts. Classified viruses by histological symptoms. Kenneth M. Smith, 1931a: Review plant viruses in over 30 plant families. Spindle tuber not known in British Isles. Doubts some reports of insect transmission. Leafroll not transmitted artifically. Aphid transmission varies with region, with individual, and with virus. No effect by viruses on bodies and salivary glands of aphids. Vectors may have biological races **re** transmission. Labergerie, 1931: Less degeneration in tubers produced by shoots exposed to current oscillating in copper. Von Brehmer, 1931: Has not yet grown organism (of the Archimycetes) earlier claimed by him to be causative agent. Discusses "cell-therapy" which in another article (1931b) he discusses similarly with some application to potato viroses. He states (1931a) that potato viroses being due to an organism are different from physiological degeneration. Von Brehmer and Rochlin, 1931: Distinguish between common "necrobiotic" tissue and virotic tissue necrosis, by polarized light and michrochemistry. In the Report of the Proceedings of the Fifth International Botanical Congress held at Cambridge, England, in 1930 (published in 1931 and available from the MacMillan Co., New York) a discussion on the differentiation and classification of plant viruses is given, including abstracts of some papers. In addition, Salaman (p. 386) stated that there were virus-free stocks in two English potato varieties while Murphy (p. 388-389) stated that virus-free plants of a considerable number of varieties had been discovered. The Congress passed a resolution for an international standing committee on plant viruses (p. 18).

Relation of viroses to seed improvement. Martin and Mott, 1931: Give general data on viroses and seed certification—its history, value, and relation to viroses. Advise tuber-unit seed plots, isolated by 300 feet, and personal inspection of foundation stock. Yield correlated somewhat with disease in one season, but is affected more by seasonal variation. Yielding power maintained in New Jersey with freedom from disease, leafroll probably being most serious there and rugose mosaic probably being more serious there than mild mosaic. Jensen and Morris, 1931, p. 9, 28: Yielding power decreased by irrigation conditions due to more rapid spread of viroses. Conn. A. E. S., 1931, p. 4-5: Viroses give trouble in physiological studies in spite of control measures. Mann, 1930, p. 63: In Rurals in New York, mosaic causes loss of 14 per cent when present, is abundant in much certified seed, and is influenced in symptoms by environment. Greenhouse tuber indexing removes much disease; field roguing often prevents increase. Increase varies with season and aphids, but not with leaf hoppers. Folsom, Owen, and Smith, 1931: Study of apparently healthy strains and tuber lines requires understanding viroses, which usually cause greater differences than strain differences in yield rate, and sometimes in tuber weight and tuber type. Giant hill described, may be infectious (p. 39), can increase yield through frost resistance (p. 53). Russet Rurals infected with mild mosaic and leafrolling mosaic, with symtoms not long clear (p. 75). All tested Green Mountains carried one or more masked mosaics (p. 2, 5). Of yield loss from roguing single hills, over half can be made up by adjacent hills (p. 17). Skips between tuber units may cause tubers to vary more in weight (p. 21), and skips if large may prevent yield increase in hills nearest to rogued units (p. 27). Gardner, 1930, p. 12-13: Best control by single-tuber clon stocks, secured in several varieties. Kotila, 1931: As preceding, with explanation of methods and of difficulty of maintaining freedom from disease. Stuart, 1931, p. 16, 18; In a Farmers' Bulletin, spindle tuber is omitted from a table of common diseases. Continuous selection required to maintain good seed stock, roguing alone not being sufficient.

Bailey, 1930: Prince Edward Island and northern New Brunswick are better for foundation stock than Vermont, while leafroll and mosaic are the most troublesome factors. Tucker, 1931: Uncertified potatoes in Canada can

not legally be advertised or sold as seed. Gussow, 1931, p. 195-197: Defines foundation stock as that showing no more than 0.3 of one per cent virus diseases. In Novia Scotia most tuber lines became too diseased for certification in 5 years. All tuber lines yielded high. MacLeod, 1931: In nearly healthy stock, size of tuber not correlated with viroses. Koeslag, 1930: Describes seed certification in Holland, where selection is expected to gradually eliminate viroses. Costantin, 1930: High altitude and cold make better seed potatoes through increasing resistance to viroses. Costantin, 1930a: Explanation of preceding—through limiting extension of disease, facilitating selection of healthy individuals, and possibly suppressing or attenuating disease. Costantin and Lebard, 1930 and 1930a: High-altitude commercial potatoes yielded less than selected healthy stock, and yielded in proportion to freedom from viroses.

Viroses in Relation to Potato Degeneration. Bijhouwer, 1931: Senility theory of degeneration replaced by virosis explanation, except for some Germans. [This article is "an abbreviated English version" of a Dutch article: Bijhouwer, 1930]. De Groene, 1931: Mosaic spread in Holland more as soil was lighter in texture, but charts show that root or foliage contact was not the determining factor. Leafroll entered a plot on light soil. In another test, early roguing reduced mosaic spread greatly. Jaguenaud, 1931: Degeneration is affected by time of planting and rapidity of vegetative cycle, through effect of radiant energy, and also is affected by soil type and soil moisture. Schander et al., 1930: Degeneration varies with place and variety. Yielding power could not be forecast by sprout study or nitrogen determinations. Yield, with disease content (blackleg and viroses) depended upon the source of seed. In Germany the theory that potato degeneration is caused directly by environmental factors is variously explained and defended by Morstatt (1931), Merkenschlager et al. (1931 1931a), Schwarz and Klinkowski (1931), and Ziegler (1931). Schweizer (1930) describes extensive chemical studies of the effect of leafroll on the plant. Certain chemical treatments produce, and others eliminate, symptoms of viroses. A discussion by Opitz (1930) of experiments in Germany and of the relationship between degeneration and weather, soil, time of digging, shading, and chemical constitution, does not seem to lead to definite conclusions. Kock in Austria (1930) considers that degeneration has more than one cause, a principal one being viroses, such as mosaic and leafroll, the latter being confused with a Fusarium leaf-rolling disease. Recommends selection of high-yielding plants. Kohler (1930) in Germany would suggest that among the various divergent theories bearing upon potato degeneration, the truth probably lies near the middle, with viroses important. Possibly there is also a purely environmental degeneration. Pieper, 1930: Degeneration of the kind caused by viroses, is the most important cause of yield reduction in large parts of Germany, but varies with place, season, and soil type. Permanent degeneration should be distinguished from temporary effects of abnormal fertilizers or of soil or storage conditions. Remy et al., 1930: Degeneration at Poppelsdorf in Germany is chiefly or solely due to disease. Verplancke, 1931a: Degeneration in central Belgium due to viroses, mild mosaic of U. S. type and leafroll being the most common ones present. Frisolee is given as synonymous with rugose mosaic. Pittman and Elliott, 1930: In western Australia, viroses, considered as the main causes of degeneration in type and yield, are masked in the summer by the heat.

Not available. Some publications probably of interest but not available for reviewing are marked by * in the list of Literature Cited where they are included.

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Announcement of the 19th Annual Meeting of the Potato Association of America to be held at the

Lennox Hotel, Atlantic City, New Jersey

December 28 and 29, 1932

Crop and Market News

Fewer Potatoes, But Markets Weak

(Contribution from the Bureau of Agricultural Economics)

Potato production prospects decreased considerably during August, and the September forecast was 357,000,000 bushels, or 19,000,000 less than last year. In Aroostook County, Maine, rainfall had been above normal and late blight spread rapidly. The New York crop had too little rain and too high temperatures for the best development. Michigan and Wisconsin had favorable weather during August, but other North Central States reported less favorable conditions. Other states in the important late-producing areas were affected by drought. The 18 surplus-producing late states by September 1 expected only 252,000,000 bushels, or 11,000,000 less than on August 1 and 10,000,000 less than last year. Favorable conditions in the other late or deficient-producing states resulted in a slight increase to 40,755,000 bushels, or 4,400,000 more than last season. Production in the intermediate States decreased slightly during August and was considerably less than in 1931.

Carlot movement was increased with the harvesting in northern or main-crop states. By late September, shipments of potatoes were averaging 500 cars per day but were still one-sixth lighter than last year. The North Central area and western states were shipping more than any other district. Maine and New York were lagging far behind last season's record. By mid-September, total output of the 18 surplus-producing late states was only 10,600 cars, compared with 16,000 the year before, and intermediate shipments by rail showed a similar shortage.

Markets were weak and prices low. New Jersey Cobblers had declined to 70c per 100-pounds sacked, on an f.o.b. basis, after having been considerably higher. Maine shipers were getting only 35c on sacked Cobblers and 25c on bulk stock, compared with 50c-55c sacked the year before. Growers in northern Maine were getting only 30c-35c per barrel measure, with Green Mountains slightly higher. In southeastern Minnesota, f.o.b. sales of Cobblers recently were returning 44c-50c per 100 pounds, and Early Ohios 39c-46c. The f.o.b. range in Wisconsin was 45c-50c, while cash-track sales of Brown Beautys in southern Colorado were being made at 25c-30c, with Red McClures at 30c-35c. Idaho Russet Burbanks were returning 40c-43c cash in the southern parts of that state, and Triumphs and Rurals ranged 25c-30c per 100 pounds. The Chicago carlot market recently reported sales of northern Round Whites at 65c-70c, Red River Ohios at 70c-75c, and Minnesota Early Ohios as low as 60c-63c per hundred-weight. Idaho Bliss Triumphs were around $1 and Russet Burbanks $1.20-$1.30 in Chicago.

Review of Recent Literature

Davidson, W. D.—Potato Growing for Seed Purpose: Identification of Varieties of Potatoes from Characteristics of Foliage, Flower and Tuber: Selection of Seed, Sprouting, Cultivation, Manuring, Planting and Spraying of the Crop for Maximum Results. Jour. Dep't. Agr. Dublin 30 No. 2, p. 259-281, 1931; 31 No. 1, p. 19-170, 1932.

The author emphasizes the posibilities in the development of a seed potato industry in the Irish Free State, and discusses the steps necessary to the production of high class seed. A list of early, second early and maincrop varieties is given for which the author considers there is a demand. Hereditary diseases of the potato such as leafroll, mosaic, etc. are discussed at some length.

Seed inspection was inaugurated in 1918. Potato fields entered for certification must meet the following requirements: (a) That the plants are vigorous, and free from any form of mosaic disease that is obviously causing a reduction in yielding capacity; (b) That they are completely free from leafroll; (c) That any plants affected with blackleg are removed, and (d) That all rogues and impurities are removed to the inspector's satisfaction. In 1925 the Department instituted a voluntary scheme of inspection whereby growers can have the produce of certified crops inspected for grading and soundness when bagged and if found satisfactory the bags are sealed by the inspectors. Cultural instructions are given for the production of a profitable crop such as the selection of a suitable variety, good seed, size of seed, sprouting, etc.

The distinguishing characteristics of different varieties are discussed under tuber, sprout, foliage, flower and date of maturity. Some 338 varieties are listed with respect to their susceptibility or immunity to wart disease and their synonyms. The remainder of the article, consisting of some 77 pages, is devoted to the varietal characteristics of some 197 varieties. The characters are discussed in the following order,—Immunity, tuber, sprout, foliage, flower, maturity, general notes. —W. Stuart.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of American Potato Journal, published monthly at East Lansing, Michigan, for October 1, 1932.

State of Michigan } ss.
County of Ingham }

Before me, a Notary Public in and for the state and county aforsaid, personally appeared H. C. Moore, who having been duly sworn according to the law, deposes and says that he is the Editor of the American Potato Journal and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Potato Association of America, East Lansing, Michigan.
Editor—H. C. Moore, East Lansing, Michigan.

Managing Editor—
Business Manager—

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given).

Potato Association of America, East Lansing, Michigan.

J. R. Livermore, Ithaca, N. Y.

J. W. Weston, Baton Rouge, La.

H. C. Moore, East Lansing, Mich.

John S. Gardner, Lexington, Ky.

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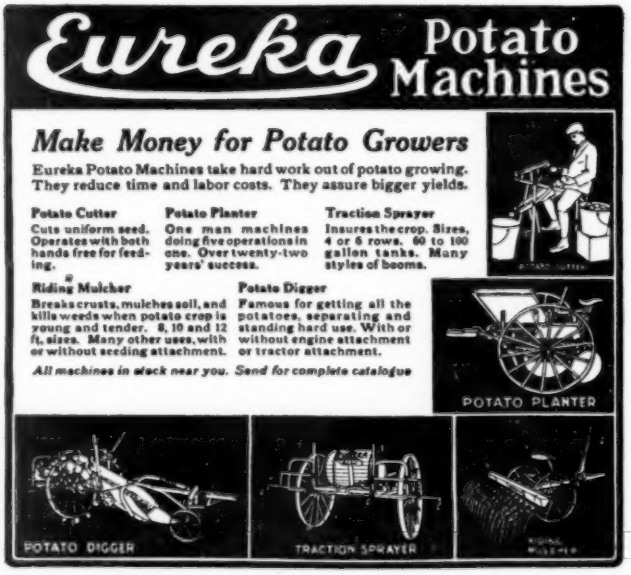
3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state). There are no bondholders, mortgagees, etc.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholders or security holders appears upon the books of the company as a trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities, in a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is—(This information is required from daily publications only).

H. C. MOORE, Editor.

Sworn to and subscribed before me this 14th day of October, 1932.
R. N. WRIGHT, Notary Public, Ingham County, Mich.
(My Commission Expires November 12, 1935).
Form 3526.—Ed. 1924.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